Contents

- Smart Range of Burst fuzes:
  - Threat: Fast Incoming Attack Craft (FIAC)
  - Multi function fuze against FIAC
  - Threat analysis
  - Necessity for additional function: Range of Burst function
  - Implementation Range of Burst function: MEDEA
- Target simulator
- MEDEA performance
- Conclusions
Threat: Fast Incoming Attack Craft

- Fast Patrol Boat
- Terrorist attack
Current Multi Function Fuzes
Answer to FIAC?

Suitable for
• Anti Aircraft mode
  • Aircraft
  • High diver
  • Sea skimmer
• Impact mode
  • Surface target (Large, Slow)
• AP mode
  • Land targets
  • Troops / personnel
• Time mode
  • Cargo
  • Troops / personnel

Optimization by:
• Target detection
• Physical contact
• None
• None
Threat analysis

Assume a scenario where 50 rounds are required for 90% kill probability

<table>
<thead>
<tr>
<th>MODE</th>
<th>Height of burst</th>
<th>Time</th>
<th>Straight</th>
<th>Weaving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight</td>
<td>90 m</td>
<td>50</td>
<td>15</td>
<td>90</td>
</tr>
<tr>
<td>Weaving</td>
<td>appr. 75 s</td>
<td>225 s</td>
<td>25 s</td>
<td>135 s</td>
</tr>
<tr>
<td>Target travel @ 50 km/h (14 m/s)</td>
<td>appr. 1000 m</td>
<td>2000 m</td>
<td>300 m</td>
<td>1200 m</td>
</tr>
</tbody>
</table>
No suitable mode for FIAC

FIAC characteristics:
• Small
• High speed
• Fast manoeuvring

Available modes:
• Time mode – inefficient due to resulting CEP
• AP mode (HoB) – inappropriate due to resulting high CEP
• AA mode – inappropriate due to low RCS and high clutter
• Impact mode – too low hit probability

New mode required with lower CEP
TNO Answer to FIAC threat: Range of Burst mode

Range of Burst mode
• Burst at given horizontal range to gun
• Improved range estimation fuze
• CEP reduction for
  • Elevation point errors
  • Air density errors
  • Muzzle velocity errors
  • …
Range of Burst operating principle

Operating principle is corrected time mode
• Calculation of time correction
  • Based on trajectory deviation
  • Based on motion sensor
Range of Burst mode implementation: MEDEA multi function fuze

MEDEA =
- Multifunctional
- Extended range
- Digital
- Electronic
- Artillery fuze

Objectives
- Multi function fuze
  - Fast patrol boats FIAC
  - Bombardment role
  - High diver & Aircraft
  - Sea skimmer
  - Super Quick / Post impact delay
  - Time

Characteristics
- Multi caliber
- Programmable
- Insensitive to EMI
- Digital processing
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Target simulator

Suitable for
• Anti Air mode
  • High divers
  • Aircraft
  • Sea skimmers (including sea clutter)
• Anti personnel mode / Height of burst mode
Target simulator principle

Function:
- Amplitude and phase controlled reflection
- Amplitude and phase control by digital signal generation
- Synchronized to fuze FMCW transmission

Advantages:
- Distance converts to frequency offset (@ FMCW)
- Radar Cross Section converts to amplitude of reflection
- Multiple targets possible
- Full height range
- Sea clutter simulation
- Hardware in the loop simulator
- Both development and production testing
Target simulator implementation
Target simulator signal

- Aircraft, High diver
  Reduced Doppler frequency and increased signal strength during pass.

- Sea Skimmer
  Clutter peaks at “head on” and “straight below”

- Height of Burst
  Signal strength of harmonics of modulation as function of height
Target simulator
Play back of recorded data (1)
Target simulator
Play back of recorded data (2)
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Performance

Height of Burst  -90 m
Time           -40 m
Range of Burst -12 m
FPB            +12 m
+40 m
+90 m

σ
### MEDEA performance summary

<table>
<thead>
<tr>
<th>MODE</th>
<th>( \sigma )</th>
<th>Assumed scenario 50 rounds for 90 % ( P_{\text{kill}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Straight</td>
</tr>
<tr>
<td>Height of burst</td>
<td>90 m</td>
<td>50</td>
</tr>
<tr>
<td>Time</td>
<td>40 m</td>
<td>15</td>
</tr>
<tr>
<td>Range of burst</td>
<td>12 m</td>
<td>5</td>
</tr>
</tbody>
</table>

Required time @ 40 rounds/min

<p>| | | | |</p>
<table>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Height of burst</td>
<td>appr.</td>
<td>75 s</td>
<td>225 s</td>
</tr>
<tr>
<td>Time</td>
<td>appr.</td>
<td>25 s</td>
<td>135 s</td>
</tr>
<tr>
<td>Range of burst</td>
<td>appr.</td>
<td>&lt;10 s</td>
<td>75 s</td>
</tr>
</tbody>
</table>

Target travel @ 50 km/h

<p>| | | | |</p>
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</tr>
</thead>
<tbody>
<tr>
<td>Height of burst</td>
<td>appr.</td>
<td>1000 m</td>
<td>2000 m</td>
</tr>
<tr>
<td>Time</td>
<td>appr.</td>
<td>300 m</td>
<td>1200 m</td>
</tr>
<tr>
<td>Range of burst</td>
<td>appr.</td>
<td>100 m</td>
<td>700 m</td>
</tr>
</tbody>
</table>
MEDEA operational readiness
MEDEA Army 155mm operational readiness
Conclusions

• MEDEA Multi Function Fuze suitable for virtually any target type
• MEDEA effective answer to Fast Incoming Attack Craft
  • Minimal number of rounds
  • Short intervention time

• Effective lab-testing of all RF fuzes with target simulator
  • Anti personnel / Height of Burst
  • Anti Air
    • Sea skimmers
    • High Divers
    • Aircraft